

Title: Pathways to Patterns

Brief Overview:

This learning unit can be used to introduce students to patterns and associated mathematical vocabulary. It will include the use of pattern blocks, tables, visual observations of the students' surroundings, and a brief introduction to the Fibonacci Sequence. By the completion of this unit, students will have the knowledge to create their own design using pattern blocks, to create a Fibonacci design, and to solve several numerical problems that emphasize patterns and relationships.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
Students will demonstrate their ability to solve a variety of pattern and sequence problems, primarily using manipulatives in an environment of cooperative learning.
- **Mathematics as Communication**
Students will demonstrate their ability to communicate mathematically. They will read write and discuss mathematics with the language, signs, symbols and terms of the discipline.
- **Mathematics as Reasoning**
Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments mathematically.
- **Mathematical Connections**
Students will demonstrate their ability to connect visual patterns to numerical sequences and patterns found in nature.
- **Patterns and Relationships**
Students will create a function table in which the relationship between one variable and another can be determined by the student. The student also will create a rule that identifies the pattern.

Grade/Level:

Grades 4-5

Duration/Length:

6 class days

Prerequisite Knowledge:

- Some experience with pattern blocks may be helpful but not necessary.
- Knowledge of mathematical computation as in multiplication, addition, and subtraction.

Objectives:

Students will:

- be able to identify the core of a pattern and be able to continue the given pattern.
- be able to identify existing patterns in their environment including their classroom, school facility, and adjacent surroundings.
- be able to determine the numerical sequence of selected patterns.
- be able to create a function table to solve a problem.
- use pattern blocks to create a design that uses the Fibonacci sequence.
- be able to understand and use vocabulary terms..

Materials/Resources:

- Pattern blocks (class set and translucent overhead set)
- Chart paper
- Clip boards
- Copies of worksheets
- Copy of poems with distinct pattern in sentence structure or rhyme.
- Math talk chart
- Rubric
- Polaroid camera (optional)
- Sentence strips
- Magic markers, pattern block stickers or crayons
- Math journal
- Vocabulary Words: term, core, sequence, repeat, pattern, number sequence, rule, variable, function table, geometric shapes, triangle, square, rhombus, parallelogram, hexagon, trapezoid, and inverse operations

Development/Procedures:**Day 1:**

- The teacher begins the pattern lesson by asking students what they know about patterns. Students will initially record their ideas in their math journals and then volunteers will read their entry aloud. Teacher should record student answers on chart paper. Student responses might include patterns found in nature, mathematics, poetry, art, and music.

- Explain to students that important mathematical vocabulary will be added to a chart entitled “Math Talk”. As students suggest words, such as repeat, sequence, or predictability, it is recorded on the chart.
- Distribute pattern blocks. After short period of “play time”, students are asked to make observations of their pattern blocks. Expect responses that classify by shape, color, amounts, relationship to each other. As students use geometric vocabulary to describe shapes, add these word to the vocabulary chart.
- Teacher will demonstrate to class how to create a pattern. The use of the overhead projector and translucent pattern blocks works well here. Students will be asked to create the given pattern and continue it. The vocabulary words term and core should be introduced at this time. *Term* is considered one block in a given pattern; the *core* of a pattern is the complete sequence that repeats.
- In pairs, students will each create a pattern containing at least three repeated cores and to stop before the fourth core is completed. Partners will complete each other’s patterns. Continue with two or three patterns. Share a few students’ examples with entire class. At this time a teacher can explain how to identify using letters. AABBAAB... or ABABABA.... etc.
- Teacher will distribute sentence strips to students. Have students place pattern blocks on sentence strip. Check before sticker use. Using pattern stickers or magic markers, students create a pattern containing two full cores and leave one unfinished using ... to indicate the missing part of the sequence. Teacher can show one that she made earlier. Student should label the back of their sentence strip with the letters of their pattern. Patterns strips are collected, placed around the room and used for practice throughout the unit.
- Homework: Students prepare auditory or kinesthetic patterns to share during circle time on second day.

Day 2:

- Start with circle time and have students perform patterns. Students recreate sequences.
- As students enter room, they notice their patterns placed around the room. The teacher asks for volunteers to identify several patterns. In discussion, the teacher will review core, term, repeat, and sequence.
- The teacher will put students into groups of 8 or 9 and direct students to form a pattern of themselves with at least two core repeats. Allow five minutes or so for students to form their patterns. Students take turns demonstrating their patterns in front of class. The students should identify the core with letters.

- Students will take a tour of their school and adjacent surroundings identifying different patterns in hallways, cafeteria, doorways, front entrance, and various enclosures, etc. Students sketch a few examples of patterns. The teacher can take Polaroid pictures of the examples in building.
- Homework: Sketch at least 3 patterns found in your home. Why do you suppose patterns exist in both nature and man-made objects?

Day 3:

- Review homework and have a short class discussion. As a quick review of pattern block shapes, the teacher asks students to hold up an example of the shape she calls out. Use shape cards or actual pattern blocks to review.
- Now the teacher makes a model of an ice cream cone using a triangle and two hexagons. Have students use pattern blocks to make the design. The teacher can use an overhead projector or the modeling worksheet. The teacher points out that one ice cream cone takes one triangle and two hexagons to make. Two ice cream cones take two triangles and four hexagons. Ask students to determine how many dips are needed to make 8 cones. Students will complete the table. Ask students to determine the relationship or rule between the dips and the cone. To check understanding of the relationship between the cones and the dips the teacher can use the last question of the worksheet, How many dips are needed for 58 cones? Students should use their journals to complete the solution and explanation of the problem. Have students read aloud their entries and discuss. Discuss inverse operations. Ask if I told you there were 164 dips and asked how many cones there were, what operation would you use to figure it out?
- Give students sunflower worksheet # 1. Direct students to use pattern blocks to make sunflower shape. Ask students to finish page.
- Explain to students that patterns can also be present in numbers. They are called a sequence. Give students several examples of number patterns to work, such as:
 - A. 2, 4, 6, 8, __, __, __.
 - B. 1, 3, 5, 7, __, __, __.
 - C. 1, 2, 3, 2, 3, 4, 3, 4, __, __, __, __.
 - D. 1, 4, 2, 5, 3, 6, 4, 7, __, __, __.
 - E. 9, 18, 27, 36, 45, __, __, __.
 - F. 1, 2, 4, 7, 11, 16, 22, __, __, __.
 - G. 3, 6, 4, 8, 6, 12, 10, __, __, __.
 (Refer to attached worksheet on Number Patterns)

Day 4:

- Pass out pattern blocks. Hold up a pattern sentence that students created. Have students continue pattern. Ask a student to identify the core. Ask students to identify the individual terms. Ask “what would be the 15th term”, if the core “triangle-circle-square ”continued. Have students write in their journals how they answered this problem. Discuss what would be the 100th term? Ask students to explain their answer. Discuss:
- If given the rules: The rhombus is between the triangle and the hexagon.
 The hexagon is not last.
- Create the pattern. What would the 56th term be? Discuss.
- Have student groups create rules for developing a pattern, and a question about the n^{th} term.
- Have students answer the questions.
- Discuss what was learned.

Day 5:

- Review vocabulary.
- Today’s class will focus on a pattern created by the great mathematician Fibonacci, in the year 1202.

1, 1, 2, 3, 5, 8, 13.....

- In math journals students will copy the sequence, determine the next 10 numbers, and explain how they determined the sequence.
-- The Fibonacci sequence is formed by starting with two ones. Add one plus one to get the next number, 2. To get each number in the Fibonacci sequence add the two previous numbers.
- The teacher could bring in objects or pictures from nature to demonstrate the Fibonacci numbers.

pine cones	artichoke	starfish
pineapple	sunflower	clover

- Using their pattern blocks have students create a design using their knowledge of the Fibonacci sequence. Start with one and progress through the sequence to thirteen. Have students use a different shape for each number in the sequence. Students should be given the opportunity to view other’s designs. Discuss how size and shape varies depending on blocks used.

Day 6:

- Review vocabulary.
- The teacher will now provide instruction on a more abstract level. Using worksheet #2, the teacher will model a mathematical problem, the pizza shop, that requires the use of a table to solve. The teacher will point out to the students that real-life problems often involve a pattern. Before students begin working on the problem, the teacher should give the students a copy of the rubric that will be used to grade the other two problems, and explain its use. The teacher will now direct students to solve the other two problems. Students should complete the other problems. The teacher should explain to the students that their journal entries on these two problems will be graded using the enclosed rubric. The teacher will ask for volunteers to share their written journal entries with the class and use the vocabulary of the rubric to score the entries.
- Have students complete worksheet #5. Students should explain in writing their answer and create a number sentence. Note: This is a difficult assignment and will require the students to use variables and possibly a drawing to model.

Performance Assessment:

Rubric Score for journal entries:

- 3 Student explains solution clearly using a table and number sentence and arrives at the correct answer.
- 2 Student explains his solution but is lacking an important detail, or arrives at the wrong solution.
- 1 Student attempts to make a table, drawing or solution but cannot determine a pattern.
- 0 There is no evidence of a table, drawing or solution.

Extensions

Students continue to work with input, output tables. Students learn to use function and constant key on calculator. Continue work with Fibonacci number sequence and begin work on Pascal's triangle.

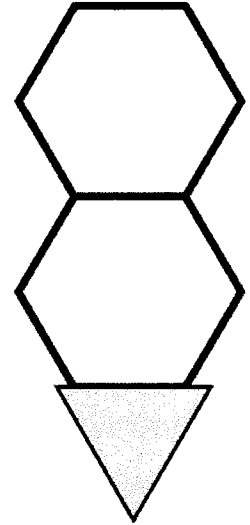
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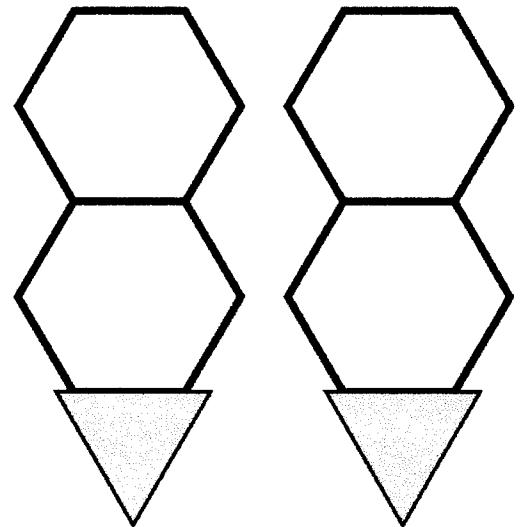
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Modeling Lesson: Patterns

One double-dip ice cream
takes 1 triangle and 2 hexagons



Two double-dip ice cream
cones take 2 triangles and 4
hexagons.



How many hexagons are
needed to complete 8
double-dip cones?

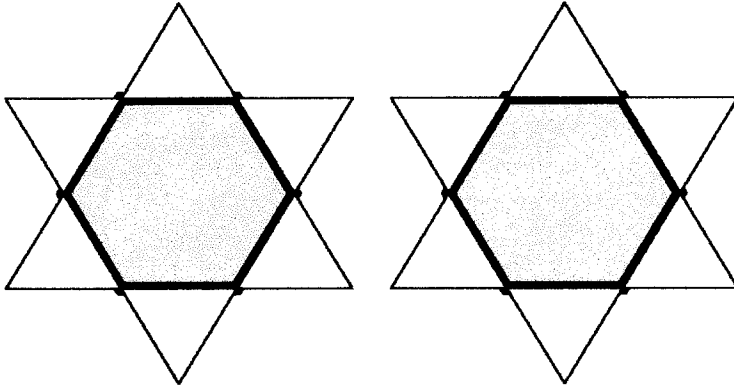
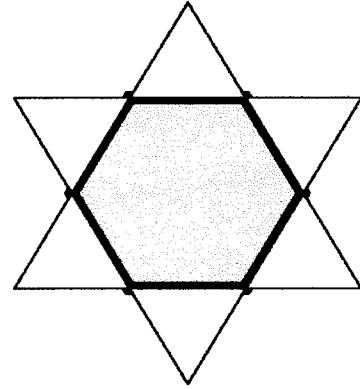
Of cones (triangles)
Of dips (hexagons)

How many hexagons are needed for 58
double-dip cones?

Now create a rule or number sentence that
defines the relationship between hexagons
and triangles.

Sunflower Patterns: #1

It takes 1 hexagon and 6 triangles to make one sunflower



It takes 2 hexagons and 12 triangles to make 2 sunflowers.

How many triangles are needed for 7 sunflowers? **Use a table to formulate your rule for this problem.

Create a number sentence that explains how many triangles will be needed for “x” number of sunflowers.

Number Patterns

Patterns can also be present in a sequence of numbers. In the following examples determine the pattern and continue the pattern for the next three numbers.

A. 2, 4, 6, 8, __, __, __, ...

B. 1, 3, 5, 7, __, __, __...

C. 9, 18, 27, 36, 45, __, __, __, ...

D. 1, 2, 4, 7, 11, 16, 22, __, __, __, ...

E. 1, 4, 2, 5, 3, 6, 4, 7, __, __, __, ...

F. 2, 4, 8, 16, 32, __, __, __, ...

G. 3, 6, 4, 8, 6, 12, 10, __, __, __, ...

H. 1, 2, 3, 2, 3, 4, 3, 4, 5, __, __, __, ...

Now create three number patterns of your own. Ask a family member to try and solve your number problems. Be ready to share one of your number patterns with a classmate. **You must be able to describe your patterns and continue the sequence yourself.

Worksheet #2: The Pizza Shop

A new owner of a pizza shop opened at a local mall. The 29-year old owner was very enthusiastic about her business. On the first day she sold only 5 pizzas but on her second day of business she sold 10 pizzas, and 15 on her third day of business. If her business continued to grow at this same rate, following the same pattern, how many pizzas could the owner expect to sell by the end of the 14th day?

Create a table to show your data.

What is the rule that will determine the number of pizzas that are sold after two weeks?

How about after 8 weeks?

Create a number sentence to express how many pizzas would be sold after X number of days.

Worksheet #3: Tomika the Track Star

Tomika, a member of a high school track team returns to practice after an injury. Her coach suggests to prevent any further injury a training program should be implemented. The program requires that she run 30 minutes the first day back. Tomika decides to run this amount plus an additional ten minutes on her first day back. She continues to extend her run, by ten minutes each day until she reaches her goal of running for two hours a day.

How many days will it take her to run for two hours each day?

Create a table to show your data. Explain in writing how you arrived at this answer.

Worksheet #4: Dog Food

Philip bought a 100 lb. bag of dog food for his poodle, Lollipop. Lollipop eats 6 lbs. of dog food per week. How many weeks will the dog food last?

Set up a chart and explain your answer.

Worksheet #5:

If given “x” number of terms in the core, how would you discover the n^{th} term in a given pattern? Use the worksheet to prove your answer.